On the inner surface of the small intestine, between the second portion of the duodenum and the ileum, a situation, as Daniels has pointed out, which corresponds with alkalinity of the bowel contents, numerous, or a few, ankylostomes will be found adherent to the wall of the gut; or, if the parasites have already dropped off, ecchymoses, not larger than a flea-bite or split pea, having pale central points, will be visible. At the necropsies of eighteen patients dead of uncomplicated ankylostomiasis, to whom no vermifuge had been administered, the number of parasites found by Sandwith was as follows: In nine of the bodies, from 1 to 50; and in the remaining nine, from 175 to 863. Ernst, of Cologne, has reported a count of 2,768 at the necropsy of a brickmaker. The little nematodes, being sometimes half buried in the mucosa, and covered with tenacious mucus, require very carefully looking for, otherwise they may be missed. Occasionally small blood cysts are found in the submucosa, containing one or more parasites. Fatty degeneration of the heart, liver, and in a lesser degree the kidneys, always occurs; the liver, from fatty changes, sometimes floats when placed in water. In the peripheral cells of the liver lobules there is found, in a very finely-divided state, bright orange-yellow pigment, which, owing to the fatty condition of the organ, may easily be overlooked. Dr. Yates reports that in a case of ankylostomiasis, where thousands of parasites were present, which recently came to necropsy at the Johns Hopkins Hospital, Baltimore, there existed, in addition to yellow pigment, necrosis of the hepatic cells surrounding the intra-follicular vein, not the peripheral cells; he also noticed that the mucous membrane of the small intestine was more or less necrosed, and that its basal layer was infiltrated with eosinophiles in enormous numbers.

In view of the marked changes found in the liver, the question of the ankylostoma being capable of producing a toxin which has haemolytic and other destructive properties must be briefly considered. Some observers firmly maintain that such is the case, and to support their views appeal to the analogous action of the bothriocephalus latus, which, although not a blood-sucking parasite, generates a blood toxin which causes profound anaemia. They point out, moreover, that the presence of such a toxin would serve to explain the occurrence of death in those cases of ankylostomiasis wherein but few parasites are found in the body on necropsy. Furthermore, Calamida, a German observer, claims to have proved that certain other entozoa undoubtedly produce toxins which not only possess active haemolytic powers, but are positively chemiotactic as regards eosinophile leucocytes. But if the opinions I have advanced on the sequence of events in ankylostomiasis are sound, the pathology of the disease, apart from the necrosis of the liver cells, is already sufficiently clear. That true haemolysis takes place is not yet conclusively proved, for the presence of yellow pigment in the liver, on which this view is based is not, as Stockman has shown, a *sine qua non* of haemolysis in the strict sense of the word. To explain the necrotic changes in the liver, the presence of a toxin seems necessary, but it has yet to be established that this morbid condition is a constant, or even frequent, feature of ankylostomiasis.

Prevention and Treatment.

The means of prevention of ankylostomiasis are fully expressed by the word "sanitation." It has been shown that the ova of the parasite will not develop into embryos unless the dejecta containing them are exposed to the oxygen of the atmosphere; consequently all that is necessary to arrest the spread of and stamp out the disease is to prevent this exposure taking place by burying the excreta. But, simple as the remedy is, the difficulties of applying it, without an Act of the Legislature making burial compulsory, are, in my opinion, insurmountable. It is, I think, the duty of sanitary officers to do all in their power to secure the compulsory introduction of some simple system of village sanitation whereby ignorant villagers will no longer be suffered to pollute their dwellings and poison themselves with their own excrement. But to obtain the necessary legal authority a good deal of pressure must be brought to bear on the executive, and until medical men themselves fully realize the fatal nature of ankylostomiasis they are unlikely to convince others that village insanitation is productive of such heavy mortality from that disease. (Sandwith has pointed out that solar heat destroys the ova and kills the embryos, provided exposure is thorough and prolonged.)

For the treatment of ankylostomiasis there is no vermifuge comparable to thymol. Three doses of the drug are generally

given on the same day, at intervals of either half an hour or some hours. If after four or five days ova are still found in the dejecta, the thymol should be repeated as at first. This plan of treatment should be continued until all the parasites are expelled. The dose of thymol as a parasiticide is from 10 to 60 gr., according to the views of different men. The maximum dose, if used at all, should be reserved for fairly robust patients, while not more than 10 gr. should be given for a dose to those who are very ill or much advanced in years.

It can be administered in rice paper or stirred up in water. A good plan is to keep a solution in spirit of a definite strength, and pour the prescribed dose, at the time of giving it, into 2 oz. of water, which will release the thymol in a finely-divided state.

In using thymol the same precautions in regard to food and purgatives should be taken as when using other anthelmintics. The physiological effects of thymol closely resemble those of carbolic acid, and in cases of ankylostomiasis admitted into hospital in a prostrate state it is sometimes advisable, before administering the drug, to improve the patient's condition by a short course of digitalis and judicious feeding.

CONCLUSION.

Time has not permitted me to enter more fully into the many and varied features of this disease, but I venture to hope sufficient has been said to secure for it your earnest and serious consideration. Treated early ankylostomiasis is easily cured, but neglected it tends to a fatal issue. Therefore the dejecta of all persons who are received into hospitals, gaols, and asylums in the tropics should be searched for the ova of the parasite; and the diagnosis of no tropical disease associated with anaemia should be considered complete until this investigation has been made, in whatever country the person suffering may come under observation. If the precaution to examine the evacuations of the patient who became the subject of a necropsy at the Johns Hopkins Hospital had been taken, his life would doubtless have been saved, whereas he died of anaemia with his disease unrecognized.

No clinical examination of a patient living in a tropical country where parasiticism is such an important etiological factor in disease can be deemed adequate which does not include a microscopical study of his blood and dejecta.

TRYPANOSOMIASIS ON THE CONGO.

By PATRICK MANSON, C.M.G., M.D., LL.D., F.R.S.

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THE publication of the case of trypanosomiasis alluded to in the columns of the BRITISH MEDICAL JOURNAL some months ago, and at present under my care in the wards attached to the Tropical School at the Albert Docks, has been delayed intentionally, pending developments. Meanwhile I have received information about a similar case, also a lady, and whose infection was also acquired on the Congo. As this second Congo case presents several features of a suggestive character, both as regards the manner in which the infection was acquired and also as regards the symptomatology, I have thought it well to bring it forward, although the information about it is very incomplete, in the hope that by calling attention to the points I refer to further information bearing upon them may be elicited.

History.—On July 17th, 1901, a lady, aged 40, consulted me about a fever from which she had been suffering from time to time, and which was invariably preceded and accompanied by an erythematous rash on the face and trunk. The fever, she informed me, recurred with regularity about once in ten days; each attack lasted three days, and was followed by seven days of complete apyrexia. Rigor was not a prominent symptom. The erythema occurred in spots and patches varying in size from an inch in diameter to a patch 1 ft. across. Usually they presented a ringed appearance. The erythema subsided with the temperature. The patient informed me that she had resided for two terms, of two years and one year respectively, on the Congo. It was during the last of these that the disease developed. Both she and her husband dated her illness from the middle of 1900, and attributed it to a bite on the foot. What inflicted the bite they did not know but believed that it was an insect. The foot swelled and must have given considerable trouble, for "boracic lotions were used to take down the swelling." Two or three days after being bitten she sickened with what her husband described as a "big fever" of two months' duration. The temperature did not reach the absolute normal for quite three months. Erythema was a feature of the fever from the commencement. Being pregnant at the time she left the Congo for England. Throughout the voyage she suffered from fever. She arrived in England in April, 1901. A week later she was confined prematurely of an eight months' child. Since the confinement, and until

the time I saw her in July, she had had these attacks of fever and erythema about once in ten days. There had been a good deal of rheumatic-like pain in wrists, knees, and ankles, partially relieved by salicylates, which she said caused profuse sweating. She complained of weakness of vision, which I attributed to asthenopia from general debility.

Condition when First Seen.—The patient was somewhat anaemic but I detected no visceral disease; the spleen and liver were not noticeably enlarged. Unfortunately, from want of leisure, I made no blood examination.

After-history.—I again saw the patient in April, 1902. Meanwhile she had consulted an eminent dermatologist, who suggested that the erythema from which she continued to suffer might be a toxic eruption due to the quinine she had been taking more or less systematically. The quinine was accordingly suspended. She informed me that her general health had improved since her previous visit, notwithstanding the fatigue and anxiety of nursing her baby, who had been very delicate and who had died some eight months after its birth. She certainly looked better. The fever had been in abeyance for a considerable period until about three weeks before this her final visit to me. During these three weeks, and apparently in consequence of a cold, she had had three slight attacks; these were, as usual, associated with erythema, though the eruption was distinctly less pronounced than formerly.

Diagnosis of Trypanosomiasis.—Some three months later this lady and her husband returned to the Congo. I heard no more about her till lately, when I received letters from her husband and from Dr. Sims, of Leopoldville, announcing that Dr. Broeden, of the Leopoldville Bacteriological Institute, had found a trypanosoma in her blood. I gather from Dr. Sims's letter that reading of the cases of trypanosomiasis recently described, he had been led to suspect the nature of this lady's illness, and had got Dr. Broeden to examine the blood. Her husband writes: "Her general health is now really good and she is much stronger than when in England; the fevers do not pull her down. Her eyesight, which had been affected, is now restored. She has had fevers for nearly five months every ten days; as soon as the fevers are over she is perfectly well; they are very slight. The fevers do not seem to be as trying as ordinary malarial fevers, especially those she is having now."

Dr. Sims informs me that Dr. Broeden subsequently found another case of trypanosomiasis in an official whose blood swarmed with the parasites; and he mentions a third case in which the patient went mad, and in whom, judging from the clinical symptoms, presumably fever and erythema, he surmised that the trypanosoma was present.

Thus within a few months we hear of no fewer than four cases of trypanosomiasis in the very limited European community on the Congo. From this we are driven to infer that trypanosomiasis must be alarmingly common in that part of Africa.

Etiology.—In the case related above the patient and her husband associated her illness with the bite on the foot two and a half years ago, and which was followed within two or three days by a severe continued fever of several months' duration. We have exactly the same history in the case of the other poor lady at present in the Seamen's Hospital suffering from advanced trypanosomiasis, namely, a sore on the leg, attributed to insect bite, and followed by a three months' fever—the initial fever which issued in a more chronic recurring intermittent fever.

The same sequence of events in the two cases strongly suggests that the virus in both instances was introduced by a bite. It would therefore be of great practical importance to ascertain what the animal that inflicted the bite may be. The thought occurs to me that this may be the poisonous tick of bug-like habits (*Argas moubata*) that Livingstone and afterwards Sir John Kirk and others have described as occurring at Tete and other places in the Zambesi valley. The following notes on this animal and its effects will appear in the forthcoming edition of my *Manual of Tropical Diseases*. The information is somewhat hazy, but it may be of assistance to any one having the opportunity to clear up what seems to me to be a cardinal and very important point in the etiology of trypanosomiasis.

ORNITHODORUS MOUBATA (*Argas moubata*, Murray).

Dr. Livingstone was the first to describe the tick disease of Portuguese South Africa. He met with it at Ambaca and Tete on the Zambesi. He says: "The effects of the bite are a tingling sensation of mingled pain and itching, which gradually ascends the limb until it reaches the abdomen, where it soon causes violent vomiting and purging. When these effects do not follow, as we found afterwards at Tete, fever sets in; and I was assured by intelligent Portuguese there that death has sometimes resulted from this fever."

Later, Sir John Kirk referred to the same disease, which he found in the Zambesi valley as high up as Sescheke, above Victoria Falls. "The symptoms," he says, "appear soon after the bite, and are sharp fever, vomiting, and often delirium; in about two days these pass off, but there is no marked profuse perspiration as in malarial fever. After recovery the patient has complete immunity from further attacks however he may be bitten, but it is doubtful whether this immunity lasts for any length of time in case of removal."

Dr. Dowson, R.N., in a letter accompanying specimens of the tick sent to the British Museum, says: "The Portuguese believe that the severity of the subsequent symptoms depends on the number of bites received. Severe fever and dysentery, with great swellings around the anus, are stated to have occurred.....A Dutch trader assured me that he was bitten by one of these acari on the toe, and that the bite was very painful. A few hours later he was seized with most violent abdominal pain, vomiting, and purging. The stools contained blood. He was ill for three days afterwards, but said there was no fever at all."

Dr. Daniels, writing to me from British Central Africa, says: "I have come across tick fever. Usually several ticks must bite; they produce a small lump, which remains for two or three days. In from five to ten days the subject of the bites gets an attack of abdominal pain with vomiting and purging. The stools are somewhat dysenteric. This lasts for nearly a week, and is accompanied by fever and rigors. After that, fever continues often for three or four weeks. Some people are not susceptible; others get only one attack; a few may have several, but in time they also become immune. The case I saw, an adult, was in the second week of the illness, and the purging had stopped. The temperature ranged from 100° F. to 102.3° F. Three blood examinations were negative. There were no physical signs."

In Tete the tick is called *kufu* or *bu* by the natives, *tampan* or *garrapato* by the Portuguese.

Mr. Pocock, the distinguished arachnologist of the British Museum, considers the Tete tick to be identical with *Ornithodoros moubata* found by Welwitsch in Angola. It has been confounded with *O. Savignyi* of Egypt, Somaliland, and British East Africa, but it differs from this allied but non-pathogenic species in several minute anatomical details.

O. moubata extends across Africa along the Zambesi valley and its tributaries. In habit it resembles the common bed bug; it inhabits old houses, hiding during the day in cracks and moving about actively during the night in search of the blood of man or beast. In some districts the natives protect themselves from the pest by plastering the walls and floors of their huts with mud and cow-dung; a practice adopted by the Boers, the Bechuanas, and nearly all the cow-keeping native tribes. They frequently smoke their huts to drive the ticks from their lodgement in the thatch. The Portuguese at Tete have a great dread of the *garrapato*, and always warn new arrivals not to place their beds on the ground, and to be careful to have the inside of their mosquito nets carefully searched for the tick before retiring for the night.

Amblyopia.

The patient in the case here reported complained at one time of defective vision. I made no detailed examination of the fundus, nor am I aware that she was seen by an expert ophthalmologist. Curiously enough, our patient at the Seamen's Hospital has a peculiar condition of the fundus oculi—a disseminated choroidal atrophy with pigmentary disturbance. It would be well, therefore, in suspected cases of trypanosomiasis to make an ophthalmoscopic examination. If choroidal disease be a usual feature in the infection, its discovery would be of value in diagnosis, especially in those cases in which the trypanosomes are very scanty in the peripheral circulation.

Prognosis.

The improving health in this last case encourages the hope that immunity may be acquired after a time in human trypanosomiasis, and that, therefore, the disease is not necessarily fatal.

TRYPANOSOMIASIS AND ITS CAUSE.

By ALEX. MAXWELL-ADAMS, JUN.,

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BEFORE alluding to the causation of this disease I would make some remarks as to the question of priority of the discovery of the parasite. My grounds for doing so are that I observed the case on board the steamer before the researches of Dr. Dutton took place, and for four months afterwards had constant opportunities of following its progress. Finally at Bathurst I had the pleasure of a demonstration of the parasite in the blood by Dr. Dutton himself. I think that the priority of laying this discovery before the scientific public rests with Dr. Dutton, as announced first by telegraph from the Gambia, and afterwards published in his classical paper. There can be no doubt that Dr. Forde had previously observed a strange organism in the blood of his patient, and it is to be regretted he did not put this on record at the time.

The name "trypanosoma Gambiæ" proposed by Mr. Dutton for this parasite is entirely inappropriate, as Dr. Manson has since shown it to have a greater geographical range, and I think it would only be a graceful thing to associate the name of Dr. Forde with it, and term it the "trypanosoma Fordii."

To the exact description of the clinical symptoms given by Dr. Dutton I would add a few remarks as to the puffiness of the eyelids observed in the case. This was entirely confined